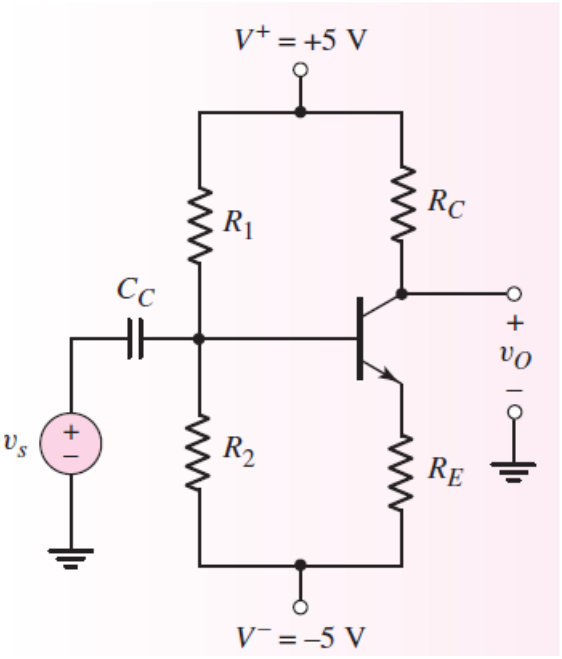
ECE322L -Homework 7-solutions (100 points)
Assigned on Thursday, 03/05/2020-11 am
Due on Thursday, 03/12/2020-11 am

Consider the circuit below. The transistor parameters are $\beta = 150$ and $V_{BE}(on) = 0.7$ V. The circuit parameters are $R_E = 2$ kΩ and $R_C = 10$ k Ω. Design a bias-stable circuit such that the quiescent output voltage is zero. What are the values of I_{CQ} and V_{CEQ}?



$$I_{CQ} = \frac{V^+ - V_o}{R_C} = \frac{5-0}{10} = 0.5 \text{ mA}$$

$$I_{EQ} = \left(\frac{1+\beta}{\beta}\right) I_{CQ} = \left(\frac{151}{150}\right)(0.5) = 0.5033 \text{ mA}$$

$$V_{CEQ} = (V^+ - V^-) - I_{CQ}R_C - I_{EQ}R_E$$
$$= 10 - (0.5)(10) - (0.5033)(2) = 3.99 \text{ V}$$

Now

$$I_{BQ} = \frac{I_{CQ}}{\beta} = \frac{0.5}{150} \Rightarrow I_{BQ} = 3.33\,\mu\text{A}$$

$$R_{TH} = (0.1)(1+\beta)R_E = (0.1)(151)(2) = 30.2 \text{ k}\Omega$$

$$V_{TH} = \left(\frac{R_2}{R_1 + R_2}\right)(10) - 5 = \frac{1}{R_1}(R_{TH})(10) - 5 = \frac{1}{R_1}(30.2)(10) - 5$$

Also

$$V_{TH} = I_{BQ}R_{TH} + V_{BE}(on) + I_{EQ}R_E - 5$$
$$= (0.00333)(30.2) + 0.7 + (0.5033)(2) - 5 = -3.193 \text{ V}$$

Then

$$\frac{1}{R_1}(30.2)(10) - 5 = -3.193$$

or $R_1 = 167 \text{ k}\Omega$ and $167 \| R_2 = 30.2 \Rightarrow R_2 = 36.9 \text{ k}\Omega$